MONITORING PLAN

PROJECT NO. BA-20 JONATHAN DAVIS WETLAND RESTORATION

ORIGINAL DATE: July 10, 1995
REVISED DATE: July 23, 1998

Preface

Pursuant to a CWPPRA Task Force decision on April 14, 1998, the original plan was reduced in scope due to budgetary constraints. Specifically, water level and salinity will be monitored continuously through 2005. Upon collection and evaluation of this data set, the Technical Advisory Group (TAG) will assist in development of a sampling plan based on an approximate 30% reduction of effort, if technically advisable.

Project Description

The proposed project area totals 7,199 ac (2,880 ha) of wetlands classified as intermediate marsh located in Jefferson Parish within the Barataria Basin (U.S. Soil Conservation Service 1994). The project area is bounded on the north by the Pailet Canal, on the east by La. Hwy. 301, on the south by Bayous Perot and Rigolettes, and on the west by the Gulf Intracoastal Waterway (GIWW) (figure 1).

Vegetation in the project area is dominated by *Spartina patens* (marshhay cordgrass) and *Sagittaria lancifolia* (bulltongue). Other common species include *Scirpus americanus* (olney threesquare), *Typha* sp.(cattail), *Eleocharis* sp. (spikerush), *Juncus effusus* (soft rush), *Baccharis halimifolia* (eastern baccharis), *Panicum repens* (torpedograss), *Ipomoea sagittata* (morning-glory), *Bacopa monnieri* (waterhyssop), *Alternanthera philoxeroides* (alligatorweed), and *Hydrocotyle* sp. (pennywort) (U.S. Soil Conservation Service 1994).

The project area consists mainly of the Lafitte-Clovelly soil type with some areas of Harahan clay and Barbay muck (U.S. Soil Conservation Service 1983) (figure 2). The Lafitte-Clovelly association is characterized as level, very poorly drained, saline, semifluid organic and highly erodible soils. Harahan clay soils are level, poorly drained mineral soils in low positions on the natural levees of the Mississippi River and its distributaries. Barbay muck is a level, very poorly drained semifluid mineral soil.

Overall, 1,393 ac (557 ha) of land have been converted to open water between 1945 and 1989 (Coastal Environments Inc. 1991). The average rate of change of marsh to non-marsh (including loss to both open water and commercial development) has been increasing since the 1940s. Marsh loss rates were 0.56%/yr between 1939 and 1956. Between 1956 and 1974 loss rates were 0.69%/yr; and between 1983 and 1990 loss rates were 0.73%/yr (Dunbar et al. 1992).

It is the opinion of the National Resources Conservation Service (NRCS; formerly the Soil Conservation Service, SCS), as reported in the Marsh Plan and Environmental Assessment (1994),

Figure 1. Jonathan Davis Wetland Restoration Project (BA-20), location of project area, reference area and monitoring stations.

that major factors influencing wetland loss within the project area are increased water exchange, saltwater intrusion, tidal scour, and shoreline erosion along Bayous Perot and Rigolettes. Shoreline erosion from 1945 to 1989 caused primarily by wave action along Bayou Perot has been measured at 20 ft/yr (6.1 m/yr)(Coastal Environments Inc. 1991). Water exchange and tidal scour are believed to have been enhanced with the construction of various oil field canals. Numerous oil field canals were dredged in the 1940s when oil companies were not responsible for maintaining a continuous spoil bank along the canals. As a result, the breaches that occurred were not repaired and subsequently exposed the interior marsh to increased tidal flows and salinity during storm surges (U.S. Soil Conservation Service 1993). National Biological Survey (NBS) Geographic Information System (GIS) data from 1956 characterized the majority of the area as fresh marsh. However, the 1978 and 1990 data indicate that the area has become more saline. In both 1978 and 1990, the area was classified as primarily intermediate marsh (NBS 1978, 1990). Chabreck and Linscombe (1988) also characterize the area as intermediate marsh. Other large scale factors influencing degradation in the Barataria basin include subsidence, lack of sedimentation, and reduced freshwater influx due to the levee system on the Mississippi River and its major distributaries.

Subsidence rates based on U.S. Army Corps of Engineers (USACE) tide gage readings (1947–78) at Bayou Rigaud, Grand Isle, La., is 0.80 cm/yr (Penland et al. 1989). To compound this problem, there are no major external sources of inorganic sediment into the project area although some sediments do enter via the GIWW. Moreover, the increased tidal exchange during storm surges caused by the many oil field canals within the area has facilitated the export of a large portion of the indigenous inorganic and organic sediments (U.S. Soil Conservation Service 1994).

This project is a hydrologic restoration and seeks to reduce marsh loss and restore historical hydrologic conditions that reduce rapid water level and salinity fluctuations and are conducive to the retention of available fresh water. Measures included for this purpose are as follows (figure 2):

- approximately 1,040 ft (317 m) of low sill rock weirs (5 structures)
- approximately 70 ft (21 m) of earthen plug (1 structure)
- approximately 1,560 ft (475 m) of rock-armored earthen plugs (7 structures)
- approximately 780 ft (238 m) of breach armoring (6 locations)
- approximately 34,000 ft (10.4 km) of shoreline stabilization along the entire southern boundary of the project area

Project Objectives

1. Use structural measures to restore hydrologic conditions that reduce water level and salinity fluctuations (variability) and allow greater freshwater retention to increase quantity and quality of emergent vegetation.

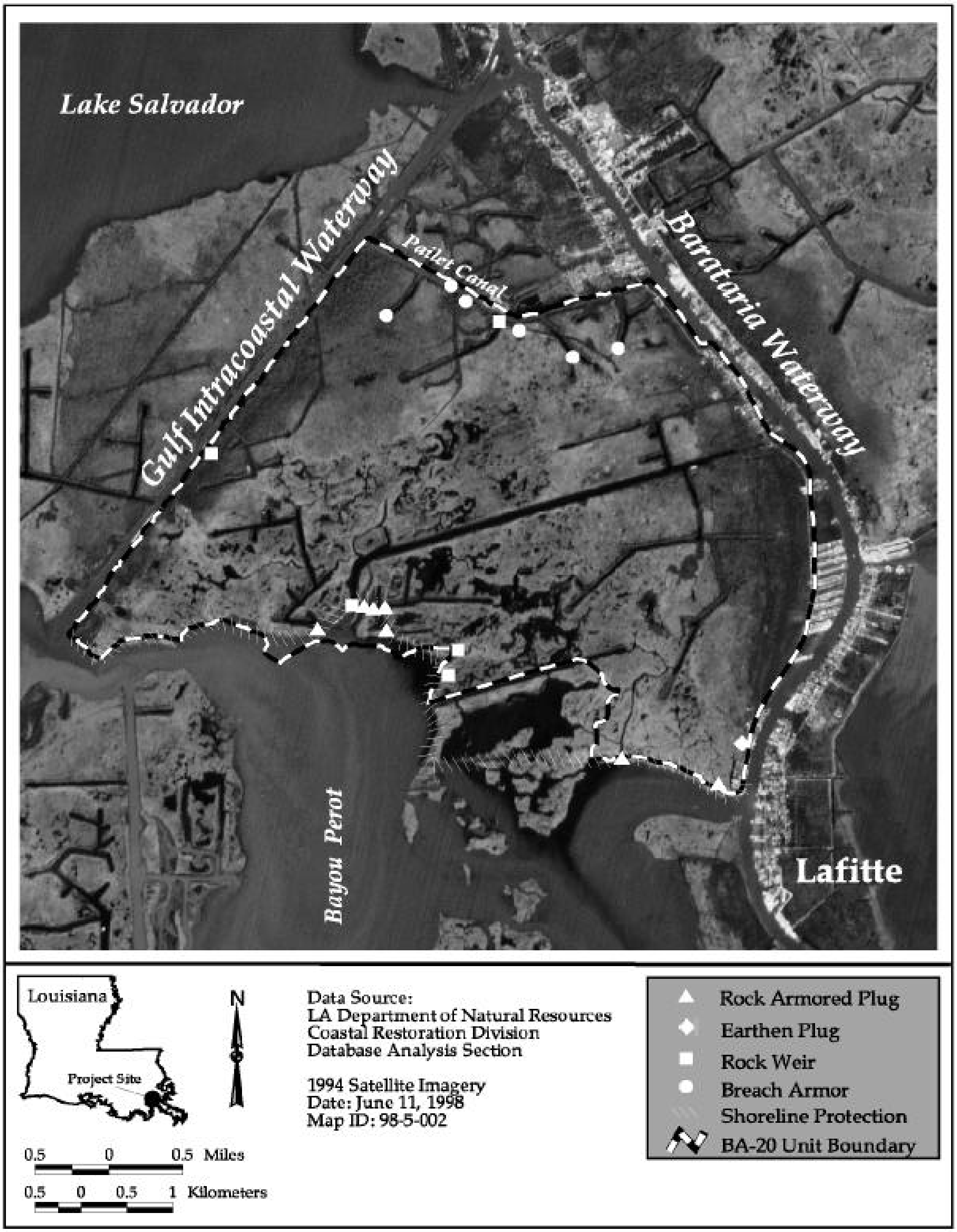

Figure 2. Jonathan Davis Wetland Restoration Project (BA-20), location of project area and features.

2. Reduce wetland loss through hydrologic restoration and shoreline protection to reduce erosion.

Specific Goals

The following goals will contribute to the evaluation of the above objectives:

1. Reduce existing rate of loss of emergent marsh.

2. Decrease variability in salinity within the project area.

3. Decrease variability in water level within the project area.

4. Reduce marsh edge erosion rate along southern project boundary.

5. Stabilize or increase relative abundance of intermediate-to-fresh marsh type plant species.

Reference Area

The importance of using appropriate reference areas cannot be overemphasized. Monitoring on both project and reference areas provides a means to achieve statistically valid comparisons, and is therefore the most effective means of assessing project success. Various locations in the vicinity of the project area were evaluated for their potential use as a reference area. The evaluation of sites was based on the criteria that both project and reference areas have similar vegetative community, soil, hydrology, and salinity characteristics. There were several locations chosen for use as a reference area specific to individual monitoring elements. Two areas directly to the southeast and southwest of the project along Bayou Rigolettes and Perot respectively, were feasible. In addition, the area directly north of the project above the Pailet Canal and the area above GIWW to the northwest were also suitable locations (figure 1). Theses sites were chosen because they satisfied the above mentioned criteria for choosing a suitable reference area. Both the project area and the proposed reference sites are classified as intermediate marsh (Chabreck and Linscombe 1988) and both contain mainly the Lafitte-Clovelly soil type (U.S. Soil Conservation Service 1983). Preliminary salinity monitoring indicates similar salinities in both project and reference sites. Both reference areas south of the project and the project area proper have shorelines along Bayou Rigolettes and Perot, major traversed bayous where extensive shoreline erosion is occurring.

The proposed reference site to the southeast of the project area will be used in the evaluation of all monitoring elements. The proposed reference site to the north and southwest of the project area in Bayou Perot will be used in the evaluation of salinity and water level monitoring elements. The site to the northwest above GIWW will be used as a reference site for the vegetation and habitat mapping components of monitoring. As the chosen reference sites (approximately 1900 ac [769 ha]) are smaller than the project area (approximately 7200 ac [2,914 ha]), a reduced number of sampling stations will be used for monitoring vegetation, soil samples, and shoreline erosion . The specific numbers are listed in the monitoring elements section of this plan. Aerial photography for the habitat mapping monitoring element will be flown for both the project area and the reference sites.

Some aspects of the hydrology of the reference sites to the southeast and northwest are unknown. Both the project and reference areas contain open connections to large water bodies and have natural and anthropogenic bayous running throughout, however, specific hydrologies are currently being investigated. Baseline monitoring will yield more information concerning flow patterns, water levels, and frequency and duration of flooding. The sites will at that time be re-evaluated for use as a suitable reference area.

<u>Monitoring Elements</u>

The following monitoring elements will provide the information necessary to evaluate the specific goals listed above:

1. Habitat Mapping — To document marsh to open-water ratios and marsh loss rates as well as changes in vegetative community type, color-infrared aerial photography (1:12,000 scale, with ground control markers) will be obtained by NBS for both project and reference areas. The photography will be georectified, photointerpreted, mapped, ground truthed, and analyzed with GIS by National Wetlands Research Center (NWRC) following procedures outlined in Steyer et al. 1995. The photography will be obtained twice prior to construction in 1994 and 1997, and twice after construction in 2002 and 2014.

2. Salinity — Sampled monthly at three continuous recorders located within the project area and three located in the reference sites (figure 1). Discrete salinity will be measured monthly at 17 stations in the project area using a salinometer. Both a surface and a bottom reading will be obtained at each station. Discrete data will be used to characterize the spatial variation in salinity throughout the project area and will be used in concert with the continuous recorders to statistically model the system. Monthly discrete sampling will not require any appreciable increase in monitoring time as we will concurrently be servicing the continuous recorders. Salinity will be monitored in 1995-1999 (pre-construction) and in 2000-2005 (post-construction). Upon collection of this data set, the TAG will assist the CRD Monitoring Manager with evaluation of the data and development of a sampling plan based on an approximate 30% reduction of effort, if technically advisable.

3. Water Level — Sampled monthly at three continuous recorders located in the project area and three located within the reference sites (figure 1). A staff

gage will be surveyed adjacent to the continuous recorders so as to tie recorder water levels to a known datum. Staff gages and continuous recorders will be surveyed to the North American Vertical Datum (NAVD). Marsh elevation will be surveyed at each site and used to determine annual duration and frequency of flooding. Water level will be monitored in 1995-1999 (pre-construction) and in 2000-2005 (post-construction). Upon collection of this data set, the TAG will assist the CRD Monitoring Manager with evaluation of the data and development of a sampling plan based on an approximate 30% reduction of effort, if technically advisable.

4. Shoreline Change

To evaluate marsh edge movement, GPS will be used to document marsh edge position. Several discrete stations will be established within the project area along the 34,000 ft (10.4 km) of the rock riprap shoreline protection structure. Points will be established on the actual structure as well as on the marsh edge adjacent to and behind the structure at maximum intervals of 50 ft (15.2 m) (680 points). Stations will also be established at 50 feet intervals along the marsh edge located on the reference area to the southeast of the project area (220 points). In addition, historical rates (as ft/yr loss) of erosion will be obtained (Coastal Environments Inc. 1991) and compared to erosion rates after project implementation. GPS measurements will be taken once in 1999 (as-built) and then in 2002, 2005, 2008, 2011, and 2014 post-construction.

5. Vegetation

Species composition and relative abundance will be evaluated in the project and reference areas using techniques described in Steyer et al (1995). More specifically, the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) will be utilized. Transects will be conducted once in 1996 (preconstruction) and then in 2002, 2005, 2008, 2011, and 2014 post-construction. Four 2.5 mi (4 km) and one 1.5 mi (2.4 km) transect will be run parallel to the GIWW within the project area. Plot sizes will be 2m x 2m ($4m^2$) and will be sampled at 0.5 mile increments along each transect for a total of 28 sampling plots within the project area. Three 0.5 mi (0.8 km) and one 1.5 mi (2.4 km) transect will be run in two of the reference areas and will yield 10 sampling plots (figure 1).

6. Soil Samples

Soil samples (30 cm cores) will be taken in 1999, 2008, and 2014 and analyzed to determine percent organic matter, bulk density, and soil salinity. These data will be collected along the vegetative transects at vegetative monitoring stations and will correspond with the post-construction aerial photography ground truthing.

Anticipated Statistical Tests and Hypotheses

The following hypotheses correspond with the monitoring elements and will be used to evaluate the accomplishment of the project goals.

1. Descriptive and summary statistics on historical data (1956, 1978, 1988) and data from aerial photography and GIS interpretation collected during post-project implementation will be used to evaluate marsh to open water ratios and marsh loss rates. If sufficient historical information is available, regression analyses will be done to examine changes in slope between pre- and post-conditions. In addition, the shoreline of the project area will be compared to that of the southeastern reference area.

   Goal: Reduce existing rate of loss of emergent marsh.

2. The primary method of analysis will be to determine differences in mean salinity variability as evaluated by an analysis of variance (ANOVA) that will consider *both* spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station locations, proximity to structures, and seasonal fluctuations. Historic data available from Louisiana Department of Health and Hospitals (LDHH) and USACE (as well as from any other available sources) will be used to augment those data collected by DNR/CRD for use as pre-construction data. Ancillary data (i.e., precipitation, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as correlation, trend, multiple comparisons, and interval estimation. Exploratory data analysis will be used to determine an appropriate variable for hypothesis testing (e.g. daily, weekly intervals).

   Goal: Decrease variability in salinity within the project area.

   Hypothesis A:

   H_0: Salinity variability within the project area will not be significantly less than the salinity variability within the reference area.

   H_a: Salinity variability within the project area will be significantly less than the salinity variability within the reference area.

   If we fail to reject the null hypothesis, any possible negative effects will be investigated.

   Hypothesis B:

   H_0: After project implementation at year i, salinity variability will not be significantly less than before project implementation.

H_a: After project implementation at year i, salinity variability will be significantly less than before project implementation.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

3. The primary method of analysis will be to determine differences in mean water level variability as evaluated by an ANOVA that will consider *both* spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station locations, proximity to structures, and seasonal fluctuations. Ancillary data (i.e., precipitation, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as correlation, trend, multiple comparisons, and interval estimation. Descriptive and summary statistics will be used to aid in the determination of differences in water level variability and for calculating frequency and inundation of marsh flooding. Exploratory data analysis will be used to determine an appropriate variable for hypothesis testing (e.g., daily, weekly intervals).

Goal: Decrease variability in water level within the project area.

Hypothesis A:

H_0: Water level variability within the project area will not be significantly less than the water level variability within the reference area.

H_a: Water level variability within the project area will be significantly less than the water level variability within the reference area.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

Hypothesis B:

H_0: After project implementation at year i, water level variability will not be significantly less than before project implementation.

H_a: After project implementation at year i, water level variability will be significantly less than before project implementation.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

4. The primary method of analysis will be to determine differences in shoreline erosion as

evaluated by an ANOVA that will consider *both* spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station locations, proximity to structures, and seasonal fluctuations. Historic data is available from CEI (1991) on shoreline erosion from the project area (currently 7-20 ft/yr). Ancillary data (i.e., precipitation, tidal, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as correlation, trend, multiple comparisons, and interval estimation.

Goal: Reduce marsh edge erosion rate along southern project boundary.

Hypothesis A:

H_0: Shoreline erosion rate within the project area will not be significantly less than the shoreline erosion rate within the reference area.

H_a: Shoreline erosion rate within the project area will be significantly less than the shoreline erosion rate within the reference area.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

Hypothesis B:

H_0: After project implementation at year i, shoreline erosion rate will not be significantly less than before project implementation.

H_a: After project implementation at year i, shoreline erosion rate will be significantly less than before project implementation.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

5. The primary method of analysis will be to determine differences in relative abundance of vegetation as evaluated by an ANOVA that will consider *both* spatial and temporal variation and interaction. The ANOVA approach may include terms in the model to adjust for station/transect locations, proximity to structures, and seasonal fluctuations. Ancillary data (i.e., herbivory, historical) will be included as covariables when available. This additional information may be evaluated through analysis such as correlation, trend, multiple comparisons, and interval estimation.

Goal: Stabilize or increase relative abundance of intermediate-to-fresh marsh type plant species.

Hypothesis A:

H_0: Mean relative abundance of vegetation within the project area at time i will be significantly less than the mean relative abundance of vegetation within the reference area at time i.

H_a: Mean relative abundance of vegetation within the project area at time i will not be significantly less than the mean relative abundance of vegetation within the reference area.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

Hypothesis B:

H_0: After project implementation at year i, mean relative abundance of vegetation will be significantly less than before project implementation.

H_a: After project implementation at year i, mean relative abundance of vegetation will not be significantly less than before project implementation.

If we fail to reject the null hypothesis, any possible negative effects will be investigated.

<u>Notes</u>

1.	Implementation:	Start Construction:	June 15, 1998
		End Construction:	September 15, 1999
2.	NRCS Point of Contact:	Marty Floyd	(318) 473-7690
3.	DNR Project Manager:	Joe Saxton	(504) 342-6736
	DNR Monitoring Manager:	Bill Boshart	(504) 342-9428
	DNR DAS Assistant:	Brian Zielinski	(504) 342-4123

4. The twenty year monitoring plan development and implementation budget for this project is $816,885. Progress reports will be available in September 2000, September 2001, September 2003, September 2004, September 2006, September 2007, September 2009, September 2010, September 2012, September 2013, September 2015 and September 2016, and comprehensive reports will be available in September 2002, September 2005, September 2008, September 2011, September 2014, and September 2019. These reports will describe the status and effectiveness of the project.

5. Water levels and existing marsh levels will be evaluated and used to calculate duration and frequency of flooding (MSL marsh level elevation and NGVD will be established).

6. The project area was last flown for color-infrared aerial photography (1:12,000) in November 1997 for DNR/CRD.

7. Available ecological data, both descriptive and quantitative, will be evaluated in concert with all of the above data and with statistical analysis to aid in determination of the overall project success.

8. The possibility exists for additional aerial photography being flown to augment that required for the habitat mapping monitoring element. This intermittent photography will aid in the evaluation of marsh to open water ratios.

9. Any additional sources of data (i.e., LDWF, Corps of Engineers, LDHH, etc.) will be used to better develop monitoring protocol and in evaluation of project effectiveness.

10. If DNR/CRD monitoring data, as evaluated by a statistician, reveal that an inadequate number of stations are being monitored (e.g. too few stations to detect variability in monitoring variables) the TAG will be consulted so as to rectify the problem.

11. DNR/CRD is currently monitoring the project and reference areas in order to acquire preconstruction data. Monitoring was initiated in December 1994.

12. The possibility exists that the locations of the continuous recorders may be used interchangeably with those required in the monitoring of the Davis Pond Freshwater Diversion.

13. References:

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